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METHODICAL PRINCIPLES OF THE COMPETITIVENESS ASSESSMENT OF INDUSTRIAL ENTERPRISES IN THE CONDITIONS OF THE CIRCULAR ECONOMY FORMATION

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Abstract
This study is devoted to substantiating the methodological principles of assessing the competitiveness of industrial enterprises. It is proposed to assess the competitiveness of industrial enterprises using structural-factor assessment of competitiveness management of industrial enterprises by an integrated approach, as well as to assess the intensity of competition in the industry using the Herfindahl-Hirschman index. The comprehensive index of competitiveness of industrial enterprises is based on the criteria of efficiency of production activities of industrial enterprises, financial support of industrial enterprises, efficiency of sales and promotion of industrial goods, competitiveness of industrial products. The approbation of the offered developments on an example of the metallurgical enterprises is carried out. The calculation of the Herfindahl-Hirschman index showed that in general, during the period under study, the metallurgical market is unstable and competition is quite high.

Keywords: *circular economy, competitiveness, globalization, industrial enterprises, metallurgcal enterprises.*
JEL Codes: *O1, O2, O4.*

Introduction

The urgency of issues related to the competitiveness of enterprises for many decades is beyond doubt. Today, in the context of the formation of a circular economy and rapid changes in the globalization of the principles of enterprise competitiveness remain the focus of scientists and practitioners. In general, the study of the competitiveness of enterprises is an extremely complex process of identifying parameters and monitoring various vector factors. At the same time, a competitive company in the domestic market may not be competitive in the global market.

Improving the competitiveness of enterprises in the formation of a circular economy requires its management to constantly review the criteria and methods for

diagnosing the competitive environment and the competitiveness of the enterprise in the market.

Literature review

Many scientific studies have been devoted to the study of the competitiveness of enterprises in modern conditions. The results of the research (Hwihanus et al., 2022) show that supply chain management has had a significant impact on the company's performance and competitive advantage. The purpose of the article (Alexandrova L.Y. et al., 2022) is to study the development of marketing logistics system, logistics approach to assessing the competitiveness of the enterprise, as well as solving methodological problems of managing logistics business processes and mesocompetitiveness. The authors of the study (Dovlatova G. et al., 2022) analyze the possibility of increasing the competitiveness of transport enterprises through the introduction of a quality system. Scientists have developed measures to increase the economic interests of enterprises through the development of service-oriented and customer-oriented staff.

The article (Tulchynska S. et al., 2021) proposes innovation and investment strategies to increase the potential for modernization and competitiveness of enterprises. The paper (Arefieva O. et al., 2021) is devoted to the study of the system of economic security of enterprises in the conditions of transformation of power. The authors of the scientific work (Vovk O. et al., 2021) performed economic and mathematical modeling of the integration impact of modernization on increasing the competitiveness of the enterprise.

Scientists (Kudryavtsev M.S., 2021) argue that competitiveness is the most important generalized indicator of industrial activity, which is determined by a combination of internal and external factors. The research (Ivanova N. et al., 2022) proposes a marketing strategy for the adaptation of small businesses to quarantine restrictions in the field of commercial entrepreneurship. The scientific work (Derhaliuk M. et al., 2021) is devoted to the analysis of the state policy of transformation of potential-creating space, which has a direct impact on the development and competitiveness of enterprises in the region. Within the framework of the article (Popelo O. et al., 2022) the authors proposed methodological approaches to the evaluation of innovations taking into account the processes of digitalization.

The practical significance of the researchers' work (Balanovska T. et al., 2021) is to develop specific recommendations for making sound management decisions to optimize the production structure of crop production of agricultural enterprises, focused on market demand and relevant principles of sustainable development. In the article the authors (Pavlenchyk N. et al., 2021) prove the need to use marketing management tools to increase the competitiveness of the enterprise and create a model of interaction of tools in the implementation of marketing strategies. The aim of the article (Le N.P. et al., 2021) is to develop a methodological approach to estimating the competitiveness index in the Central Highlands of Vietnam. The authors analyze the relationship between the competitiveness index and the possible involvement of enterprises operating in the region and offer a number of policy recommendations to improve the business environment in the region.

Methodical approach

To assess the competitiveness of industrial enterprises in a circular economy, we propose to use structural-factor assessment of competitiveness management of industrial enterprises by integrated and ranking approach, as well as determining the intensity of competition in the industry using the Herfindahl-Hirschman index.

To determine the complex index of competitiveness of industrial enterprises in the formation of a circular economy, we propose to use the following formula:

$$I_{ce} = 0.15E_{pa} + 0.29F_s + 0.23E_{sp} + 0.33C_c, \quad (1)$$

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where I_{ce} – a comprehensive index of competitiveness of industrial enterprises in the formation of a circular economy;

E_{pa} - a criterion for the efficiency of production activities of industrial enterprises;

F_s - criterion of financial support of an industrial enterprise;

E_{sp} - a criterion for the efficiency of sales and promotion of industrial goods;

C_c - a criterion for the competitiveness of an industrial product.

Consider the criteria for assessing the competitiveness of an industrial enterprise in the formation of a circular economy. The criterion of efficiency of production activity (E_{pa}) can be determined by the following formulas:

$$E_{pa} = 0.31U_c + 0.19R_{as} + 0.4P_T + 0.1L_p, \quad (2)$$

where U_c – unit costs;

R_{as} – return on assets;

R_T – profitability of industrial products;

L_p – labor productivity in an industrial enterprise.

To calculate the criterion of financial security (F_s) of an industrial enterprise, it is proposed to use the formula:

$$F_s = 0.29C_{ae} + 0.2C_s + 0.36L_r + 0.15C_{tra}, \quad (3)$$

where C_{ae} – the coefficient of autonomy of an industrial enterprise;

C_s – solvency ratio of an industrial enterprise;

L_r – liquidity ratio;

C_{tra} – the turnover rate of assets of an industrial enterprise.

The criterion for the efficiency of sales and promotion of industrial products can be determined using the formula:

$$E_{sp} = 0.37R_{sp} + 0.29C_{sp} + 0.21C_{up} + 0.14C_{sa}, \quad (4)$$

where R_{sp} – profitability of sales in industrial products;

C_{sp} – coefficient of stocks of finished products;

C_{up} – utilization rate of industrial enterprise production facilities;

C_{sa} – efficiency coefficient of sales activity of an industrial enterprise.

It is very important to determine the criterion of competitiveness of an industrial product:

$$C_c = \frac{I_{qp}}{C_p}, \quad (5)$$

where I_{qp} – indicator of the quality of industrial products;

C_p – cost of industrial products.

In addition to the comprehensive index of competitiveness of an industrial enterprise in the conditions of formation of a circular economy, which takes into account such criteria as: efficiency of industrial activity of an industrial enterprise, financial support of an industrial enterprise; efficiency of sale and promotion of industrial goods; competitiveness of the industrial product. To assess the competitiveness of production enterprises, we propose to use the Herfindahl-Hirschman index.The Herfindahl-Hirschman Index, this index makes it possible to identify the concentration of business in a particular area of production activity by determining the monopolization of a particular market. The formulaic appearance of the Herfindahl-Hirschman index looks like:

$$HHI = \sum_{i=1}^{N} Sh_p^2, \quad (6)$$

where HHI – Herfindahl-Hirschman Index;

Sh_p – share of products sold on the market, in our case metal products;

n – the total number of industrial enterprises on the market, in our case metal products.

The Herfindahl-Hirschman Index has a value of 0 to 1 and represents the sum of the squares of market shares of all industrial enterprises of the metallurgical industry.

If the Herfindahl-Hirschman index value has the following values:

IHH < 0,1 market concentration is negligible;

IHH = 0,1-0,18 market concentration average;

IHH > 0,18 market concentration is high.

The greater the value of the Herfindahl-Hirschmann index, the greater the market concentration.

Results

Industrial enterprises of the metallurgical sphere of Ukraine were taken to test the proposed methodology for assessing the competitiveness of industrial enterprises in the conditions of the formation of a circular economy according to the structural-factor assessment and the Herfindahl-Hirschman index.

The metallurgical sphere has its own specific features, namely in this area there are a small number of fairly large metallurgical enterprises, which for the most part have a large share of foreign capital.

For the testing of the proposed methodology, large metallurgical plants were chosen as unifying for which there is a long production cycle, among which:

- PJSC “Arselor Mittal Kryvyi Rih” (PJSC “AMKR”);
- PJSC "Zaporizhzhya Metallurgical Plant "Zaporizhstal" (PJSC "ZMP");
- PJSC "Interpipe Nizhnedniprovskiy Pipe Rolling Plant" (PJSC "INPRP");
- PJSC "Mariupol Metallurgical Plant named after Ilyich" (PJSC "MMP").

Also in the metallurgical industry in Ukraine there are such enterprises as: PJSC "Nikopol Ferroalloy Plant", PJSC "Metallurgical Plant "Azovstal", PJSC "EVRAZ Dniprovsky Metallurgical Plant", PJSC "Dniprovsky Metallurgical Plant", PJSC "Electrometallurgical Plant "Dneprospetsstal" named after A.M. Kuzmina", PJSC "Yenakiieve Metallurgical Plant". In addition to the listed enterprises, competitors in the foreign market for selected enterprises for analysis are metallurgical enterprises of such countries as Belarus, Moldova, the Russian Federation, Turkey and China. It should be noted that the production enterprises of the metallurgical sphere of Ukraine significantly lag behind foreign enterprises in the technical and technological base, which requires significant modernization, especially in the conditions of the formation of a circular economy, but despite this they remain competitive in the world market today.

Calculations of the complex index of competitiveness of industrial enterprises in the conditions of formation of the circular economy (formula 1) and its components (formulas 2-4) selected for analysis are presented in Table 1.

Table 1. Comprehensive competitiveness index in the conditions of formation of the circular economy and its components of the group of metallurgical enterprises selected for evaluation for 2018-2020

Indicator	Year	PJSC "AMKR"	PJSC "MMP"	PJSC "ZMP"	PJSC "INPRP»
Comprehensive competitiveness index of industrial enterprises	2018	11,56	10,32	8,53	10,34
	2019	11,11	10,24	9,18	8,26
	2020	11,45	10,92	9,34	6,40
Arithmetic mean		***11,4***	***10,5***	***9,0***	***8,3***
Generalized criterion of efficiency of industrial activity of industrial enterprise	2018	7,05	11	9,5	11,4
	2019	9,05	10,05	12,95	10,9
	2020	9,05	10,05	12,95	7,95
Arithmetic mean		***8,38***	***10,37***	***11,8***	***10,08***
Criterion of financial support of an industrial enterprise	2018	11,45	7,45	6,5	12,05
	2019	14,25	8,2	8,95	6,8
	2020	14.25	10	8,95	6,8
Arithmetic mean		***13,8***	***8,6***	***8,1***	***8,5***
Criterion of efficiency of sales and promotion of goods	2018	9,7	6,8	8,35	15,15
	2019	10,1	6,1	13	13,05
	2020	11,55	6,8	13,7	6,9

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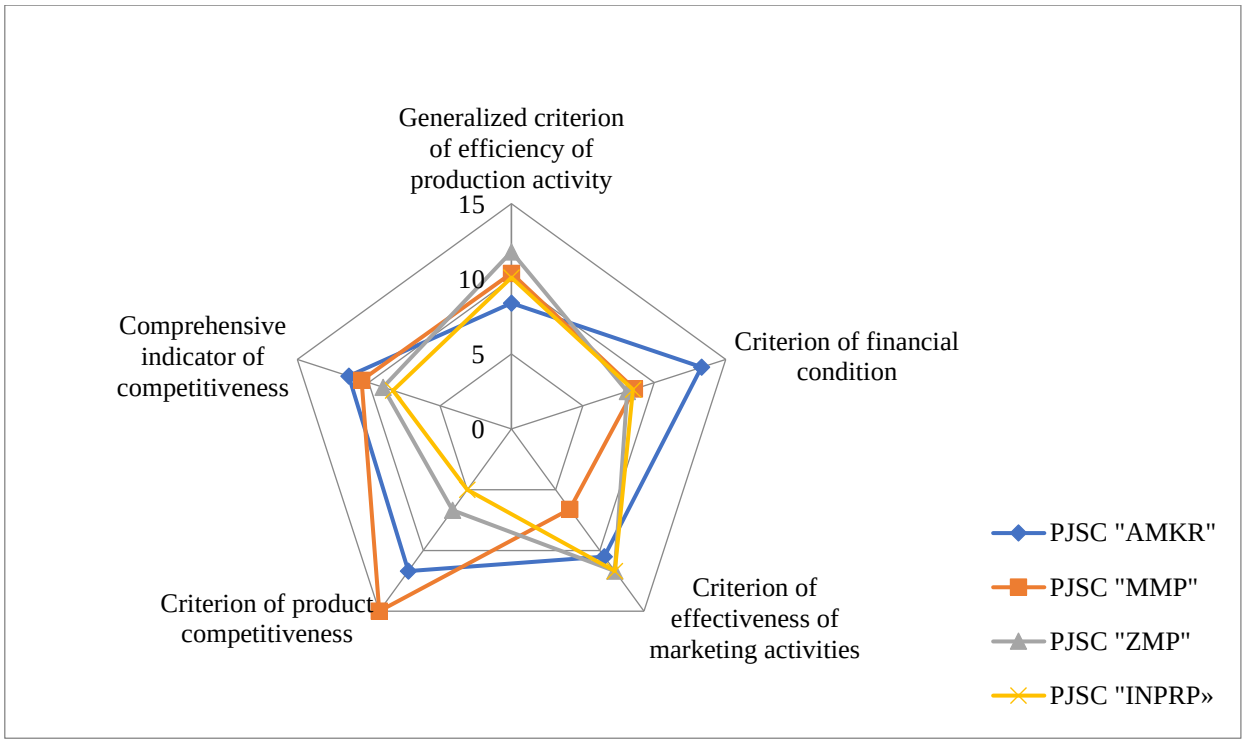
Arithmetic mean		***10,5***	***6,6***	***11,7***	***11,7***
Criterion of competitiveness of industrial products	2018	15	15	10	5
	2019	10	15	5	5
	2020	10	15	5	5
Arithmetic mean		***11,7***	***15,0***	***6,7***	***5,0***
Ranking of industrial enterprises by level of competitiveness	2018	1	3	4	2
	2019	1	2	3	4
	2020	1	2	3	4

**Source: calculated by authors.*

The obtained results of the calculations make it possible to note that the highest comprehensive competitiveness index among the studied metallurgical enterprises has PJSC "AMKR", which also has the highest value of the criterion of financial support. In second place in the comprehensive competitiveness index is PJSC "MMP", which has the highest criterion of competitiveness of industrial products. The least value of the complex competitiveness index in the conditions of formation of the circular economy among the enterprises studied is PJSC "INPRP", which also has the lowest value of the criterion of product competitiveness (Figure 1).

Figure 1. Graphical image of the results of the analysis of the complex index of competitiveness of industrial enterprises in the conditions of formation of circular economy and its components according to the arithmetic mean for the enterprises studied



**Source: built by the authors based on the results of calculations.*

Also, in accordance with the proposed methodology, the Herfindahl-Hirschman Index was calculated (Table 2).

Table 2. Components and values of the Herfindahl-Hirschmann index of metallurgical enterprises selected to assess competitiveness

Year	PJSC "AMKR"	PJSC "MMP"	PJSC "ZMP"	PJSC "INPRP»	Total
	Volume of products sold				
2018	59839129,2	31592147	23378092,7	10133613	124942981,9
2019	58494420	41940530	30463704,2	13664542	144563196,2
2020	52882687	43875603	33762398,4	16547843	147068531,4
	Market share, Si				
2018	0,4789	0,2529	0,1871	0,0811	1
2019	0,4046	0,2901	0,2107	0,0945	1
2020	0,3658	0,3035	0,2335	0,1145	1
Herfindahl-Hirschman Index					
2018	**0,3349**				-
2019	**0,3012**				-
2020	**0,2936**				-

**Source: calculated by authors.*

The results of the Herfindahl-Hirschman index calculation make it possible to note that it ranged from 0.3349 in 2018 to 0.2936 in 2020 during the study period, this indicates that in general, during the study period, the metallurgical market is unstable, and competition is quite high. When calculating the Herfindahl-Hirschman index, the volumes of products sold were analyzed, PJSC “AMKR” is leading by this indicator, and the least value is given to PJSC "INPRP". The volumes of products sold are correlated with the results of the obtained integral competitiveness indices.

The main directions of increasing the competitiveness of metallurgical enterprises in the conditions of the formation of a circular economy are:

- prolongation of effective cooperation with existing customers and attraction of new consumers in the world market by entering new commodity markets;
- improving the quality of metal products, taking into account innovative production methods aimed at maximizing the satisfaction of the needs of consumers of the metallurgical market;
- network expansion and optimization of costs for the maintenance of finished product warehouses;
- establishing the production of new types of products, taking into account changes in consumer demand;
- modernization of the technological process with the use of modern energy-efficient technologies and ensuring environmental safety;
- reducing the cost of production, which is especially important with the ever-increasing cost of energy carriers and the use of the principles of the circular economy;
- maintaining existing and ensuring an increase in competitive positions in the domestic and world markets;
- improving sales efficiency in domestic and world markets through the use of modern marketing activities.

Conclusions

The application of the proposed approach to assessing the competitiveness of industrial enterprises in the conditions of the formation of a circular economy using a structural-factor assessment based on an integral approach, as well as determining the assessment of the intensity of competition in the industry using the Herfindahl-Hirschman index makes it possible to note that the metallurgical market is unstable and competition is quite high.

The scientific novelty of the study is the introduction of a structural and factor assessment of the competitiveness of enterprises in the conditions of formation of a circular economy, which provides for the definition of the Herfindahl-Hirschman index

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and a comprehensive competitiveness index for industrial enterprises in the conditions of formation of a circular economy, which is based on taking into account the criteria for the efficiency of industrial activity of an industrial enterprise, financial support of an industrial enterprise, efficiency sale and promotion of industrial goods, competitiveness of industrial product.

The most competitive among the studied enterprises is PJSC “AMKR”, which also has the largest volume of products sold, despite the fact that it has a rather low criteria for the efficiency of production activities. Despite the fact that PJSC “INPRP" has the lowest value of the integrated index among the enterprises studied, the company has significant potential to increase competitiveness in the market. In general, with the exception of PJSC "AMKR", all enterprises need to take measures to increase the competitiveness of products in the metallurgical market. But taking into account the specific features of the metallurgical sphere, it can be noted that the demand for its products largely depends on the general state of economic development of the country and global world processes of economic development. Also influential on the comprehensive competitiveness index is the criterion of financial support of an industrial enterprise, which in most cases requires its increase.

Further scientific research and practical application require the issues of interaction and mutual transparency in ensuring the economic security of industrial enterprises and increasing their competitiveness based on the ecologization and modernization of production activities in accordance with the principles of the circular economy.

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